

# SIDDHANT TANDON

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## SUMMARY

- 2+ years of full-time research experience in machine learning, involving behavior cloning and transfer learning, in systems engineering, involving space mission operations and CubeSat testing, and in design, of satellites, and spacecrafts
- Collaborated on 5 multidisciplinary projects of which a MARS UAV project resulted in an AIAA conference publication
- Presented at the AIAA Scitech 2020 Conference, iCubeSat 2018, 3 industry-academia workshops and submitted 5+ research reports
- 15+ certificate courses in machine learning, computer vision and data mining
- Equipped to solve problems in controls, multi-agent systems, reinforcement learning, numerical optimization and computer vision

## EDUCATION

- **University of Michigan**
  - M.S.E., Aerospace Engineering May 2021
- **Udacity**
  - Self Driving Car Engineer Nanodegree Expected Dec 2021
  - Robotics Software Engineer Nanodegree Expected Dec 2021
  - Sensor Fusion Engineer Nanodegree Expected Dec 2021
  - Deep Reinforcement Learning Nanodegree August 2020
  - Flying Car and Autonomous Flight Engineer Nanodegree May 2020
  - Machine Learning Engineer Nanodegree August 2019
- **Purdue University**
  - B.S., Aeronautical and Astronautical Engineering May 2019
  - Minor in Earth, Atmospheric and Planetary Sciences May 2019

## RESEARCH EXPERIENCE

**Gorodetsky Group: Computational Autonomy, University of Michigan** Ann Arbor, USA  
Graduate Research Student May 2020 - April 2021

- Conducting research on extracting winning strategies from multi-agent environments (like games) using behavior cloning and inverse reinforcement learning
- Collaborating with a research group on extracting eigenfunctions of expert players
- Implemented a variational autoencoder(VAE) to extract low dimensional features for cloning expert behavior
- Creating interfaces with Atari games for expert-cloned models to play games and compare performance against experts
- Developing a high-performance compute framework to train and test model at-scale on University of Michigan's in-house clusters
- Developing potential ideas for developing higher fidelity VAE model by incorporating computer vision techniques, like object tracking, to mine dynamics information from experts

**Flight Dynamics & Hybrid Systems Lab, Purdue University** West Lafayette, USA  
Undergraduate Research Student September 2017 - April 2019

- Conducted literature research on designing SLAM algorithms for indoor UAV operations from sources like WiFi, gravitational and magnetic signals
- Integrated ROS on UAV for facilitating indoor experimentation

**Institute of Space Systems, Technical University of Braunschweig** Brunswick, Germany  
Research Intern May 2018 - August 2018

- Title - Design, Installation and Qualification testing of an air-bearing table for Spacecraft Proximity Operations
- Collaborated research with multiple postdocs for increasing utility of the air-bearing table
- Developed and designed multiple test procedures for improving the air table environment
- Used test results to achieve stable motion of mock-satellites

**Planetary Systems and Surfaces Lab, Purdue University** West Lafayette, USA  
Undergraduate Research Intern February 2016 - August 2016

- Title - Validating particle size and mass distribution curves of different accretion rates for Phobos and Deimos
- Developed numerical simulations in Python to show relation between mass and disk size as a function of accretion rate

## PROJECTS

- **Visual Navigation for Autonomous Aerial Vehicles**
  - Developed motion based control for drone racing simulator on ROS using C++
  - Tested feature mapping techniques like SIFT, SURF, ORB, FAST + BRIEF on real video datasets
  - Implemented GTSAM to solve SLAM problems and YOLOv3 for object detection in simulations
  - Designed a LiDAR forest simulator for testing Fast-Planner (from HKUST) a path re-planning algorithm
- **Navigation and Guidance of Aerospace Vehicles**
  - Developed a position fixing algorithm for spacecraft in around Mars using two star bearing measurements

- Implemented a Kalman Filter for a drone flying in an inclined circular trajectory
- **Model Predictive Control**
  - Tested a highway speed controller for smooth motion of autonomous cars
  - Implemented a Kalman Filter to increase accuracy in estimation of position and velocity of autonomous vehicles
  - Designed a parking controller for cars to create optimal paths to parking spots autonomously
  - Developed a collision avoidance controller for cars to facilitate safe autonomous driving around obstacles
- **Multi-agent Control**
  - Developed a collision avoidance controller for a multi-agent system
  - Designed an obstacle avoidance controller for a multi-agent system to navigate safely in an obstacle environment
  - Added a W-MSR filter to a multi-agent controller to filter out malicious signals from bad or misbehaving agents
  - Implemented a formation flying algorithm for a multi-agent system for directed, un-directed, cyclic and k-circulant communication graphs
- **Reinforcement Learning and Artificial Intelligence**
  - Implemented a DQN to play Atari games on OpenAI Gym to develop an expert neural network player
  - Implemented an A3C algorithm to play Doomviz, an AI testbed developed on the game DOOM, to clear a level in the game in minimal time
- **Motion detection and object tracking using Opencv**
  - Developed optical flow to track marathon runners using various shi-tomasi parameters
  - Tested dense optical flow to detect motion in a game, to extract trajectory information of mobile agents
  - Designed single object tracking to obtain trajectory information of a vehicle in a video
  - Implemented multi-object tracking to obtain trajectory information of multiple vehicles in a video
  - Added edge detection in live video to extract features from the environment
  - Applied a face detection and smile detection algorithm using Haar-cascades for a live video camera
  - Implemented SSD algorithm with CNN training to detect humans and dogs in a video
- **Specialized Terrestrial Rotorcraft Explorer (SPECTRE)**
  - 3 year multidisciplinary project on conceptual design of a UAV for Mars
  - Led a team of 40 senior students as Project Manager, presented the critical design review to sponsors from Lockheed Martin and Boeing.
  - Led a subteam of 5 as Controls Lead second year, defined autonomous operations for selected rotorcraft designs and demonstrated applications on Crazyflie2.0 drone
  - Led the team of 12 as Science Lead first year, defined science objective as conducting aerial survey to find possible biosignatures in Jezero Crater on Mars. Developed a Science Traceability Matrix as per NASA standards

## TEACHING AND MENTORING EXPERIENCE

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|---|-----------------------------|
| • Grading Assistant for First Year Engineering 132 Course     | January 2018 - May 2018     |
| • Note-taker for students with disabilities                   | August 2016 - December 2016 |
| • Mentor of 40 middle school students during Purdue Space Day | 2016                        |
| • Mentor of 30 elementary school students Purdue Space Day    | 2015                        |

## AWARDS

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| • First Place, AIAA Student Region III Conference    | April 2019                             |
| • Graduate Fellowship 2019, Curadev Pharma Pvt. Ltd. | August 2018                            |
| • Dean's List  | April 2015 - April 2016, December 2018 |
| • EPICS 'We Delivered', Purdue University            | December 2015                          |

## SKILLS

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**Programming Languages** Python, MATLAB, Julia, and C/C++

**Languages** English: professional proficiency. Hindi: native.

**Other** Tensorflow, Pytorch, Opencv and Unity

## PUBLICATIONS

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B. Chen, S. Tandon et al., "Behavioral Cloning in Atari Games Using a Combined Variational Autoencoder and Predictor Model." IEEE Congress on Evolutionary Computation 2021, Kraków, Poland.

T. Hutchinson, N. Marquand, J. Springer, T. Swedes, S. Tandon, and J. Zyck, "Specialized Terrestrial Rotorcraft Explorer", AIAA Scitech 2020 Forum. January 2020.

## CONFERENCE PRESENTATIONS

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- N. Marquand, S. Tandon, "Specialized Terrestrial Rotorcraft Explorer." AIAA SciTech 2020 Forum, Orlando, FL, USA. January 2020.
- S. Tandon, "Demonstration of Self Organized Cubesats." iCubesat Workshop, Paris, France. May 2018.